cola on the 27th. Its probable course in the Caribbean from the 18th to the 22d is shown in fig. 2, copied from part of Chart IX of the September MONTHLY WEATHER REVIEW. Now it is remarkable, in connection with our present subject, that the high clouds, which, as already stated, had been coming from the east-northeast down to the 17th, came from the northwest on the morning of the 18th. Dense clouds prevented observation of the high clouds on the 19th, but they were again seen to have the direction from the northwest on the 20th and 21st, which, after our study of fig. 1, is just what we might look for in St. Croix with a storm center in the middle of the Caribbean. The further passage of the Pensacola storm was not shown by high cloud movements here; on the 22d the movement was from the southwest, on the 23d from the west-southwest, and for the six following days it continued around these points.

Lastly, we may compare the high cloud movements at St. Croix with the course of the great Central American-Cuban cyclone of October last year. These clouds, which had been coming for several days from the west and southwest, were found early on the morning of the 18th to be moving from the northwest. The same afternoon came the telegrams announcing the great gale near Havana on the 17th. Later news told us of its destructive effects among the Florida islands, then at Miami, whence, as we were told by telegrams, the center had moved off to the *northwest*. If this last statement is correct, the present example has only this value, that it shows that some other causes must have been at work to produce the deviation of the high clouds now to be mentioned. On the 19th they were moving from the north; on the 20th, at 7 a. m., from north-northeast; on the same day at 5 p. m. again from north; and on the 21st from east-northeast. The direction on the 22d was not ascertained, but on the morning of the 23d they moved from east with extreme slowness, later in the day from northeast or east-northeast; on the morning of the 24th slowly from an easterly point, but at noon slowly from north, at 6 p. m. slowly from about west. Thus the abnormal movement ended on the 24th. It would be very interesting to know where the cyclone was during that time. Was the telegram correct, or was *northwest* put for *northeast?* I should think it likely that there was a mistake, the truth being that the vortex crost Florida and continued its course on the Atlantic far to the north of these Danish Islands, and that the high cloud movements followed this vortex around, as in October, 1905.

If it proves to be likely that there was a connection between the cirrus clouds and the cyclone in the above last-named case, then this connection existed at a distance of about 1200 miles, the distance between St. Croix and Havana. That would be a very striking fact if we could establish it.

Without including any doubtful cases, it seems to be made pretty certain, from the first two cases dealt with in this article, that the direction of the high clouds within the influence of a cyclone depends on the distance of the cyclone center from the observer. Father Viñes, himself, noticed that his theory about the varied direction did not always hold good, but he styles the departure from his theory an irregularity, and ascribes it to a cause which, in the opinion of the present writer, is non-existent. He writes, on page 12 of the pamphlet: "As the cyclone moves off to the north of the Tropics and is converted into a cyclone of middle latitudes, the currents gradually lose their regularity, altho their gradation continues the same. Sometimes, however, the movements of cirrus clouds present great irregularities; thus, for example, when the vortex lies to the northwest or north-northwest in the Gulf States, the current of the cirrus clouds is apt to suddenly come from the northeast. In such a case, I believe that the current observed is a resultant of the superior current of the cyclone acting together with the superior general current which at that time of the year comes from the eastern quarter."

Is it true that the upper current moves during the hurricane season from an eastern quarter? I think not, having never seen any good evidence for it. Here, in the eastern Caribbean, the evidence, so far, seems to hint that it may ultimately be possible to show that the upper current moves at all times from a westerly point, unless disturbed by a cyclone or some other special cause. This is probably the case, not only over these islands to the windward, but at Havana also. In a former number of the REVIEW Mr. Page, speaking of the high cloud movements at the latter place, mentions the different directions of cirrus clouds there, and, if I remember correctly, the proportion of normal movements (from westerly points) is large, if not even in excess of the movements from easterly points.

In the above nothing has been said about the rate of movement of the cirrus clouds, but this is evidently an important factor. If, for example, the high clouds whose direction is noted in fig. 1 took twenty-four hours to reach St. Croix, say from position *A*, then the arrow line *b* and not *a* would answer to *A*. It is probable, however, that the distances are traversed in a much shorter time. It is very difficult to form a conception of what a cyclone is really like; but if it turns out to be true that the outflowing upper current can make itself felt a thousand miles away, then it must leave the center with immense force and speed. Occasionally we come across an observation which confirms this view; for example, in Mr. Page's account, referred to in the beginning of this article, we read in the notice from the Chief Officer of the *Texan*, which was bound from Liverpool to Jamaica, and fell in with the great storm on October 9, and came to the "immediate outskirts of the vortex" on the 10th, that "the 9th set in with a moderate southwesterly wind, a northerly swell, and weather exceptionally clear and fine, the sky being cloudless save for *rapidly forming long cirrus feathers passing quickly across from west-northwest*". We can only guess what the starting rate is, and of course it gradually falls off, so as finally to become comparatively slow; but it is probable that we shall not have to allow much time for the progress of the clouds when the distance is only four or five hundred miles.

It would no doubt be rash to say that every divergence of these high clouds from a westerly point of origin is caused by a cyclone; there may be other causes. During the hurricane season last year (August, September, and October, 1906), eight such divergences were noted here. They were August 12–14; August 17; August 26; August 30–September 8; September 10–17; September 30; October 8–10, and October 18–24. The dates are mentioned here so that readers who know something about the cyclonic movements in this part of the world last year may get our side of the matter for a first rough comparison, if they care to make it.

Deviations of the high clouds from the westerly point of origin seem to be very rare outside the hurricane season. I will mention, however, one which was observed here on November 10, 1905. From the early morning of that day till about midday, well characterized cirrus clouds, mostly small, but some of considerable size and feathery, were moving at a moderate rate from southeast by east. Remembering the great distance to which it seems possible for a cyclone to send a stream of high air, we must admit that these clouds *may have come* from a point far out over the Atlantic toward the northeast. Was there such a cyclone there? Was it the same as the great storm which met the *Atrato* on the morning of the 11th and broke over the southern coast of England on the 12th? It would be very interesting, from the point of view of the present article, to know the history of that cyclone.

HAILSTORM AT CORPUS CHRISTI, TEXAS.

By JOSEPH L. CLINE. Dated Corpus Christi, Tex., June 1, 1907.

A hailstorm visited this place Friday, May 31, 1907, during

the progress of a thunderstorm. Thunder was first heard at 3:28 p. m.,[1] and last at 5:42 p. m. During this interval there were two distinct storms; both came from the west and moved toward the east. The first past to the south with no rainfall at this station, and before it was beyond the range of hearing the second came up and past just north of the station, causing rain from 4:44 to 5:02 p. m., amounting to .57 inch, most of which fell between 4:50 and 4:59 p. m. Hailstones of various sizes began falling at 4:38 p. m. (six minutes before the rain began) and ended at 4:54 p. m. All hailstones were flat and elongated, with sharp edges. Many were three-fourths of an inch in diameter the longest way. Some that were examined closely were frozen solid, with crystal ice at center, while the nuclei of others were amorphous ice. A few were found with holes thru them at the center on the flat side, having a shape like an elongated ring or hollow doughnut. It is believed that this form was due to the center being water, or raindrops, that were liberated by the melting of the sides of the hailstones when exposed to a temperature above freezing. Some of the largest hailstones had water, apparently fair-sized raindrops, in the center, while they were frozen solid on the outside, indicating that they froze after the formation of raindrops, and were not subjected to freezing temperature long enough to cause them to become solid ice. Only a few of the nuclei of those examined contained air bubbles, while many of the small ones were clear ice, making the entire hailstone appear one solid piece of ice. From the observation it appears that the centers or nuclei of all depended solely upon the surrounding temperature during and after the condensation of the vapor in the atmosphere. Those with centers not solid were constructed of only one solid layer of ice over the nucleus, the thickness depending on the size of the hailstone. The peals of thunder and flashes of lightning did not appear to have any connection with the fall of hail; lightning was visible and the sun came out during the latter part of the hailstorm. The wind velocity was light.

SPECIAL TEMPERATURE OBSERVATIONS MADE ON LOW GROUND IN THE VICINITY OF VICKSBURG, MISS.

BY W. S. BELDEN, Section Director. Dated Vicksburg, Miss., May 22, 1907.

It is a well-known fact that on relatively clear nights, with light wind velocity, the temperature is lower in lowlands and valleys than on adjacent uplands. The records of the Weather Bureau show that under these weather conditions the night temperature in cities is higher than that which prevails in the surrounding open country of the same elevation; this difference is largely attributed to the fact that the superincumbent atmosphere is freer from dust motes over the country than over the city, a condition which promotes radiation from the earth's surface in the former case and retards it in the latter.

Frost is frequently reported from regular Weather Bureau stations with a minimum temperature of between 44° and 50°, the frost being generally noted in the suburbs of the city and the temperature readings made in the densely populated portion of the city [within shelters elevated on high buildings].

In order to secure more definite information along this line for Vicksburg and vicinity, a series of special observations covering the months of October and November, 1906, and March and April, 1907, was undertaken by the writer.

Two substations were established on low ground near the city, each being equipped with a maximum and a minimum thermometer, exposed in a cotton-region thermometer shelter. Both shelters were located over sod, with floors 4 feet above the ground. One of the substations, which we will call Station A, was situated in Marcus bottom, a narrow valley about one mile southeast of the observation station. There were no trees or high objects near the shelter. The thermometers were 172 feet above sea level. At the place of observation the valley was only about 150 yards wide, with rather steep bluffs on either side, and the drainage area of the valley to the point of observation was two and one-fourth square miles. The other substation, which we will call Station B, was located about two miles north of the regular observation station and in the Yazoo River bottom, near the National Cemetery. The shelter was placed at the center of a circular plot of sodded ground about 200 feet in diameter, and the nearest high object was a large one-story frame building, used as a box factory, 150 feet west of it. The thermometers were 108 feet above sea level. The Yazoo bottom is several miles wide at the point where observations were made, the station being located 160 feet from the east edge of the valley.

Station A may safely be taken as typical of meteorological conditions that prevail in the numerous narrow valleys to the south and east of Vicksburg, while Station B represents conditions in the low and level lands west and north of the city.

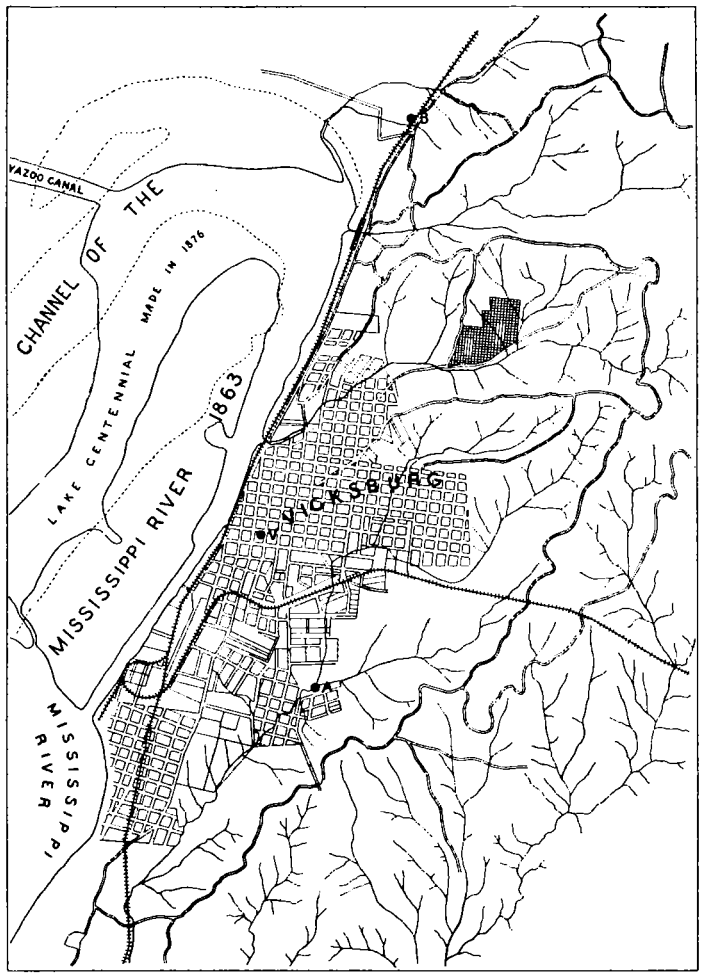

FIG. 1.—Map of the vicinity of Vicksburg, Miss., showing location of the three stations.

At the Vicksburg station the thermometers are located on the post-office building, 63 feet above ground and 289 feet above sea level. A map of Vicksburg and vicinity, showing the location of the three observation stations is reproduced (see fig. 1). Observations were carefully made at the substations at about sunset, and the temperature values of the Vicksburg station that are used in this discussion are based on maximum and minimum readings for the twenty-four hours ending at 7 p. m., local standard time [ninetieth meridian time].

[1] Seventy-fifth meridian time is used.